WILDLIFE HABITAT RELATIONSHIPS
IN WASHINGTON AND OREGON
FY2002

1. Title: **27 June 2003**

Demographic characteristics of northern spotted owls (Strix occidentalis) on the Olympic Peninsula Study Area, Washington, 1987-2002.

2. Principal Investigator(s) and Organization(s):

Dr. E.D. Forsman (PI), Lead Biologist: B. Biswell, Pacific Northwest Research Station. Research Assistants Meg Amos, Corrie Borgman, Heather Jensen, Debaran Kelso, Kurt Laubenmeir, Lyle Page, Angela Rex, and Marlene Wagner, Oregon State University.

3. Study Objectives:

a. Elucidate the population ecology of the spotted owl on Forest Service lands on the Olympic Peninsula, Washington, including estimates of population age structure, reproductive rates, survival rates, and population trends.

b. Document social integration of juveniles into the territorial population, to include age at pair formation and age at first breeding.

c. Document changes in number of barred owls within the study area.

4. Potential Benefit or Utility of the Study:

The Olympic Demographic Study was designed to monitor age-specific birth and death rates of spotted owls, thereby allowing estimates of population trend over time. From these trends we make inferences regarding the suitability of the current habitat conditions and the effects of different landscape conditions on spotted owls. This study is one of eight long-term demographic studies that constitute the federal monitoring program for the Northern Spotted Owl.

We have attempted to band all known fledglings produced in the study area since 1985. As a result, we know the origin and age of most individuals that are recruited into the population, and have detailed information on population age structure and internal and external recruitment in the study area.

5. Research Accomplishments:

Study Area and Methods

The study area includes most of the Forest Service lands on the Olympic Peninsula as well as adjacent sites on lands administered by the Washington Department of Natural Resources. A companion study conducted by the National Park Service is conducted on adjacent lands administered by the National Park Service (Gremel 2002). Prior to the establishment of the Northwest Forest Plan in 1994, forest lands within the study area were managed with a primary emphasis on timber production, and much of the area was clear-cut in the 1970's and 1980's. Subsequent to the adoption of the Northwest Forest Plan, most of the area was designated as a Late-Successional Reserve in which the primary objective is to manage for old forest conditions.

Historic owl territories within the study area are surveyed each year using standardized protocols (Franklin et al. 1996). If banded owls are missing, surveys are expanded around the historic sites to determine if the owls have moved to adjacent territories. Each territory is normally surveyed at least 3 times each year to determine if the site is occupied by spotted owls and to determine nesting status and numbers of young produced by each pair of owls. All owls detected within the study area are color-banded with unique bands so that they can be resighted and identified each year without recapture.

Methods used in this study and other demographic studies of spotted owls have been described in a variety of published sources (e.g., Forsman 1983, Franklin et al. 1990, Franklin 1992, Franklin et al. 1999, Reid et al. 1999). Protocols used for determination of reproductive parameters were described in Lint et al. (1999). Resightings and recaptures of previously banded owls are used to estimate survival rates (Pollock et al. 1990, Burnham et al. 1996).

Numbers of Owls Detected on the Olympic Study Area

In 2002 we banded 35 new owls on the study area, including 29 juveniles, 5 adults, and 1 subadult. The total sample of 838 owls banded in 1987-2002 included 428 juveniles, 68 subadults, and 342 adults (Figure 1,Table 1).

Of 92 territories surveyed in 2002, 38% were occupied by pairs, 18% were occupied by

resident single owls or floaters, and 45% had no response from spotted owls (Table 2). The pattern of territory occupancy on the study area indicates a gradually declining population from 1987-1998, with a population crash in the winter of 1998-99, and a gradual rebound in 2000-2002, although not nearly to pre-1999 levels (Figure 2,Table 2). Following the population crash in winter 1998-99, we found pairs on only 16% of the territories on the study area (Table 2). Some of the missing birds reappeared in 2000-2002, but the percent

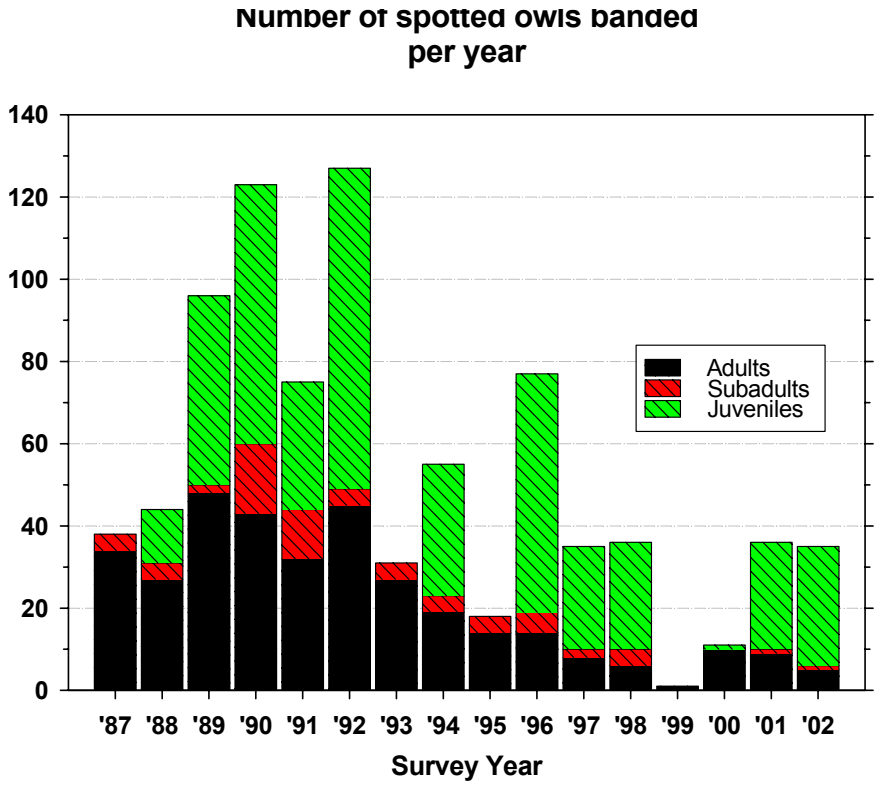


Figure 1. Number of adult, subadult, and juvenile spotted owls banded on the Olympic Peninsula study area by survey year between 1987 and 2002.

of territories with pairs was still only about 50% of the levels detected in1987-1992 (Table 2). In short, we can no longer find spotted owls in many of the areas where they occurred during the early years of our study. This is particularly true of low elevation areas on the west side of the peninsula on the Quinault and Soleduck Ranger Districts and adjacent lands administered by the DNR.

The number of non-juvenile owls detected on the study area in 2002 was 88, including 68 adults, 4 subadults, and 16 owls that were of unknown age (Table 3). This is

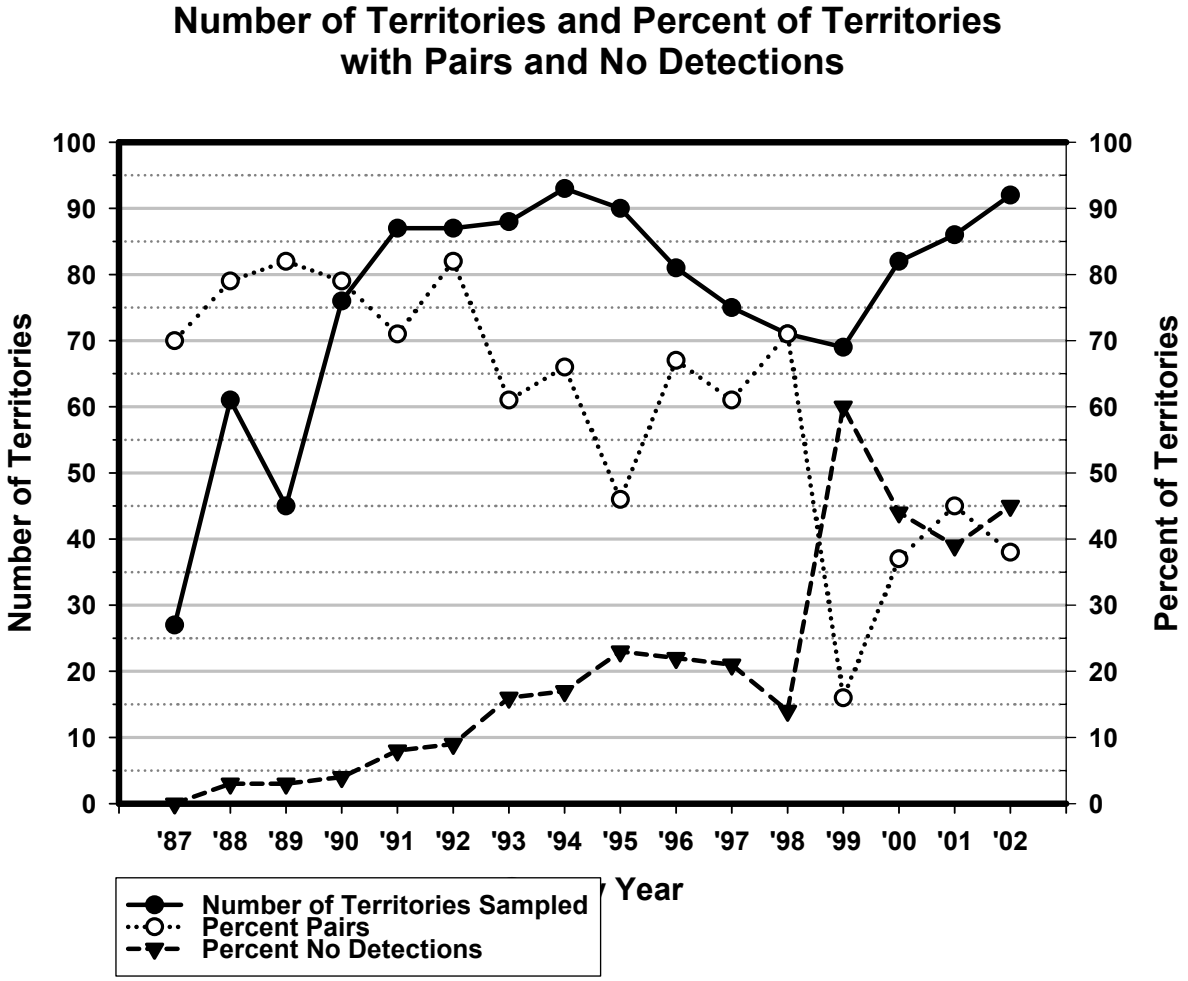


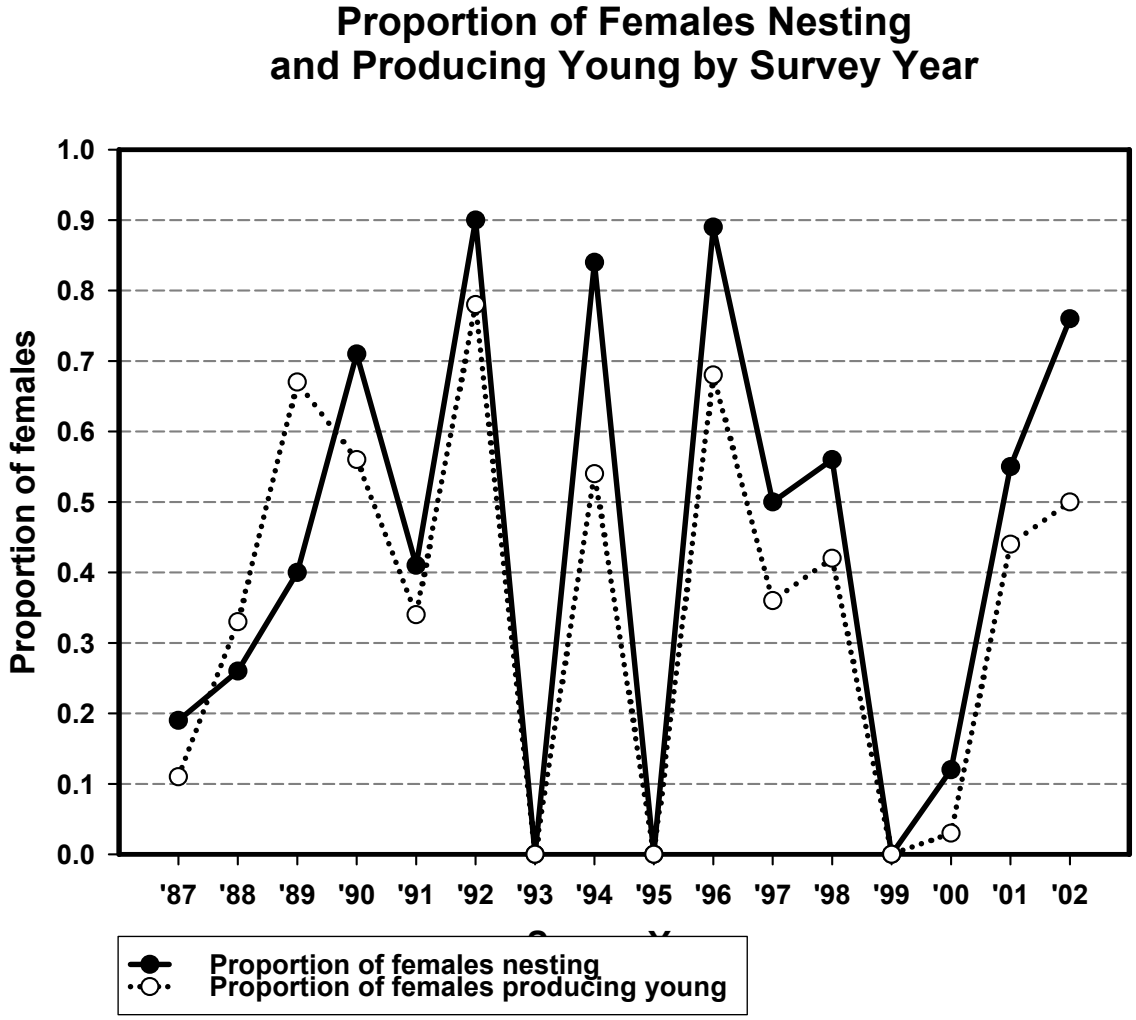
Figure 2. Number of territories and percent of territories occupied by pairs and territories with no detection of spotted owls.

approximately 60% of the peak population levels recorded in 1990-1994, with a comparable effort (Table 3).

Reproduction

In 2002, the proportion of females that nested was high (76%), but 32% of all nests failed (Table 4). As a result, only 50% of females produced young, and overall fecundity was not as high as in some of the other good nesting years (Table 5). Over the course of the study, reproduction has followed a boom and bust pattern. In the 16 years from 1987-2002 there were 6 years with high reproduction (1989, 1990, 1992, 1994, 1996, 2002), 5

years with low-to-moderate reproduction (1988, 1991, 1997, 1998, 2001), and 5 years in which few or no owls nested (1987, 1993, 1995, 1999, 2000)(Table 4). On average, only 44% of females nested, and only 36% produced young. Following the population crash in winter 1998-99, there were 2 consecutive years of almost zero reproduction (Figure 3, Table 4).



Average adult female fecundity (the estimated number of female offspring produced per resident female) in 2002 was 0.45 ± .087 (Table 5). Average female fecundity for the period 1987-2002 was 0.295 ± 0.055 (Figure 4, Table 5). On average, 74% of the females that nested produced offspring in the period 1987-2002 (Table 4). The high among-year variation in reproductive rates that we observed is typical of spotted owls

(Forsman et al. 1984, Franklin et al. 1999) . However, in contrast to some other study areas, high and low reproductive years on the Olympic Study Area did not consistently follow an alternate year pattern. For example, there were consecutive years with low reproduction in 1987-1988 and 1999-2000 (Tables 4-5).

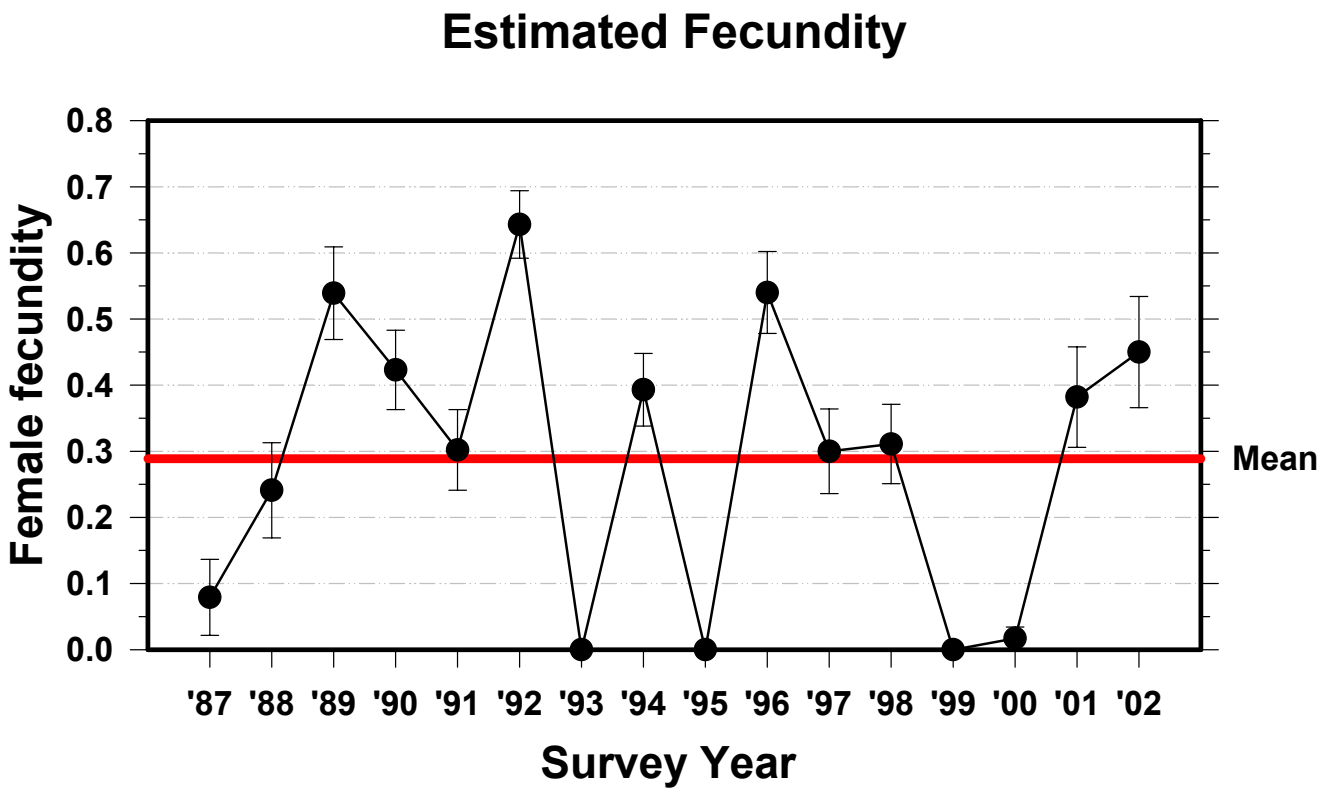


Figure 4. Annual fecundity for spotted owls on the Olympic Peninsula study area between 1987 and 2002.

6. Discussion

The analysis conducted by Franklin et al. (1999:39) suggested that the spotted owl population on the Olympic Peninsula was declining at about 6% per year. The information collected since 1998 does not suggest any improvement in this picture. We suspect that the population decline on the peninsula is due to three factors, (1) loss of habitat, (2) the

invasion of the peninsula by the barred owl, and (3) high mortality resulting from the severe winter of 1998-99. Many owl territories on our study area were impacted by timber harvest in the 1980's, and timber harvest on DNR and private lands has continued in recent years, especially at lower elevations on the west side of the peninsula.. Barred owls are gradually increasing in numbers on the peninsula, especially at lower elevations, and are invading spotted owl territories. And finally, the winter of 1998-99 was one of the most severe on record, with record winter snowfall and deep snowpacks persisting into the breeding season; apparently this killed many spotted owls, as many resident owls disappeared and were never seen again.

An unusual finding regarding reproductive trends of spotted owls on the Olympic Peninsula was the three years in which there was no breeding at all. In most other study areas in Oregon and Washington at least some owls attempt to breed in years of poor reproduction.

Inferences regarding population trends based on count data are subject to error because some owls go undetected each year. Thus count data will tend to underestimate the number of owls present because some will not be detected in any given year. While this is problem, the declines that we have observed in numbers of owls and numbers of occupied territories are too large to be explained by lack of detection of owls. Thus, we believe that the trends suggested by the data are real. A more thorough treatment of the mark-recapture data collected in this study will be conducted in winter 2003-2004, when data from all demographic studies of northern spotted owls will be analyzed.

Problems Encountered

No significant problems were encountered other than the usual inconveniences due to road closures and inclement weather, both of which are facts of life on the Peninsula. There were no accidents, no owls were injured during capture and banding, and communication and coordination with our DNR and ONP cooperators was excellent.

7. Publications and Presentations:

Forsman, E. D., R. G. Anthony, J. A. Reid, P. J. Loschl, S. G. Sovern, M. Taylor, B. L. Biswell, A. Ellingson, E. C. Meslow, G.S. Miller, K. A. Swingle, J. A. Thrailkill, F. Wagner, and D. E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. Wildlife

Monographs No. 149.

8. Acknowledgments

This study was funded by the USDA Forest Service Region 6, USDI Bureau of Land Management, and the USDA Forest Service Pacific Northwest Research Station. We work closely with our cooperators at the Olympic National Park and the Washington Department of Natural Resources to ensure coverage of owl territories, many of which overlap boundaries between landowners.

9. Literature Cited:

Burnham, K.P., D.R. Anderson, and G.C. White. 1996. Meta-Analysis of vital rates of the northern spotted owl. Studies in Avian Biology 17:92-101.

Forsman, E. D. 1983. Methods and materials for locating and studying spotted owl. USDA For. Serv. Gen. Tech. Rept. PNW-162.

Forsman, E. D., E. C. Meslow, and H. M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monograph No. 87.

Franklin, A. B., J. P. Ward, R. J. Gutiérrez, and G. I. Gould. 1990. Density of northern spotted owls in northwest California. J. Wildl. Manage. 54:1-10.

Franklin, A. B. 1992. Population regulation in northern spotted owls: theoretical implications for management. Pages 815-827 in D. R. McCullough and R. H. Barrett, eds. Wildlife 2001: populations. Elsevier applied sciences, London. 1163pp.

Franklin, A. B., D. R. Anderson, E. D. Forsman, K. P. Burnham, and F. W. Wagner. 1996. Methods for collecting and analyzing demographic data on the northern spotted owl. Studies in Avian Biology No 17.

Franklin, A. B., K. P. Burnham, G. C. White, R. G. Anthony, E. D. Forsman, C. Schwarz, J. D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. 71 pp.

Gremel, S. 2002. Spotted owl monitoring in Olympic National Park: 2002 annual report. USDI National Park Service, Olympic National Park, Port Angeles, WA. 13 pp.

Lint, J.B., B.R. Noon, R.G. Anthony, E.D. Forsman, M.G. Raphael, M. I. Collopy and E.E. Starkey. 1999. Northern spotted owl effectiveness monitoring plan for the Northwest Forest Plan. U.S. Department of Agriculture - Forest Service. Gen. Tech. Rpt. PNW-GTR-444. 43pp.

Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. Wildl. Soc. Monograph No. 107. 97pp.

Reid, J. A., R. B. Horn and E. D. Forsman. 1999. Detection rates of spotted owls based on acoustic-lure and live-lure surveys. Wildl. Soc. Bull. 27(4):986-990.

Table 1. Number of spotted owls banded per year on the Olympic Study Area, 1987-2002. Non-juveniles are listed by age class: S1= 1 yr old, S2= 2 yrs old, Adult = 3+ yrs old.

		Males			Females			
Year	Juveniles	S1	S2	Adult	S1	S2	Adult	Totals
1987	0	3	1	17	0	0	17	38
1988	13	1	3	13	0	0	14	44
1989	46	1	0	22	0	1	26	96
1990	63	6	3	20	1	7	23	123
1991	31	5	3	17	2	2	15	75
1992	78	1	2	23	0	1	22	127
1993	0	1	1	14	2	0	13	31
1994	32	1	1	8	1	1	11	55
1995	0	3	1	12	0	0	2	18
1996	58	0	2	5	0	3	9	77
1997	25	0	1	2	1	0	6	35
1998	26	1	1	2	2	0	4	36
1999	0	0	0	0	0	0	1	1
2000	1	0	0	5	0	0	5	11
2001	26	0	0	2	1	0	7	36
2002	29	1	0	1	0	0	4	35
Totals	428	24	19	163	10	15	179	838

Table 2. Percent of spotted owl territories on the Olympic Peninsula Study Area in which we located pairs, singles, floaters, or no owls, 1987-2002. Summary is based on a subset of the total data, including only the most consistently monitored sites on Forest Service and Washington DNR lands.

Year	No. of territories monitored	% with pairs	% with single owls	% with floaters[a]	% with no detections
1987	27	70	26	4	0
1988	61	79	15	3	3
1989	45	82	10	5	3
1990	76	79	12	5	4
1991	87	71	17	4	8
1992	87	82	5	4	9
1993	88	61	18	5	16
1994	93	66	12	5	17
1995	90	46	24	7	23
1996	81	67	6	5	22
1997	75	61	11	7	21
1998	71	71	11	3	14
1999	69	16	23	1	60
2000	82	37	19	0	44
2001	86	45	9	7	39
2002	92	38	9	9	45

[a] A “floater” is a single owl that was seen or heard on at least one occasion, but could not be confirmed as a resident on a particular territory.

Table 3. Number of owls detected per year in the Olympic Peninsula Study Area, 1987-2002. Counts were limited to a subset of owl territories that were surveyed most consistently on Forest Service and DNR lands. Age codes indicate adults, subadults, or owls with age unknown.

	Number of	Males			Females			Total
Year	territories	Adult	Subad	Unkn	Adult	Subad	Unkn	owls
1987	27	19	2	5	18	0	3	57
1988	39	29	4	3	29	0	4	69
1989	61	53	1	2	46	1	3	106
1990	76	55	9	5	57	6	4	136
1991	87	66	5	6	58	5	4	144
1992	87	67	4	5	65	7	2	150
1993	88	60	3	7	52	1	9	132
1994	93	56	3	12	60	2	8	141
1995	90	54	2	6	41	0	7	110
1996	81	49	5	5	48	3	6	116
1997	75	50	1	3	45	1	4	104
1998	71	51	4	5	45	3	7	115
1999	69	17	0	2	17	0	3	39
2000	82	40	1	3	31	0	4	78
2001	86	36	1	12	38	0	8	95
2002	92	37	4	10	31	0	6	88

Table 4. Proportion of female spotted owls that nested, fledged young, and nested and fledged young, Olympic Peninsula Study Area, Washington, 1987-2002.

	Proportion of females that nested[1]			Proportion of females that produced young[2]			Proportion of nesting females that produced young[3]		
Year	N	Mean	95% C. I.	N	Mean	95% C. I.	N	Mean	95% C. I.
1987	16	0.19	0.00 - 0.40	19	0.11	0.00 - 0.26	3	0.67	0.00 1.00
1988	19	0.26	0.05 - 0.48	27	0.33	0.14 - 0.52	5	1.00	-
1989	20	0.40	0.16 - 0.64	39	0.67	0.51 - 0.82	8	1.00	-
1990	35	0.71	0.56 - 0.87	52	0.56	0.42 - 0.70	24	0.63	0.42 - 0.83
1991	46	0.41	0.27 - 0.56	53	0.34	0.21 - 0.47	19	0.79	0.59 - 0.99
1992	48	0.90	0.81 - 0.99	63	0.78	0.67 - 0.88	43	0.86	0.75 -0.97
1993	51	0.00	-	54	0.00	-	-	-	-
1994	49	0.84	0.73 - 0.94	56	0.54	0.40 - 0.67	41	0.66	0.51 - 0.81
1995	35	0.00	-	36	0.00	-	-	-	-
1996	37	0.89	0.79 - 1.00	50	0.68	0.55 - 0.81	33	0.67	0.50 - 0.84
1997	34	0.50	0.32 - 0.68	45	0.36	0.21 - 0.50	17	0.76	0.54 - 0.99
1998	43	0.56	0.40 - 0.71	45	0.42	0.27 - 0.57	24	0.71	0.51 - 0.90
1999	10	0.00	-	12	0.00	-	-	-	
2000	25	0.12	0.00 - 0.26	30	0.03	0.00 - 0.10	3	0.33	0.00 - 1.00
2001	31	0.55	0.36 - 0.73	34	0.44	0.27 - 0.62	17	0.88	0.71 - 1.05
2002	29	0.76	0.59 - 0.92	30	0.50	0.31 - 0.69	22	0.68	0.47 - 0.89

[1] Estimates were calculated for females whose nesting status was determined by 1 June.
[2] Estimates were calculated for females whose reproductive status was determined by 31 August.
[3] Estimates were calculated for females whose nesting status was determined by 1 June and reproductive status by 31 August.

Table 5. Estimated fecundity (f̂) of female spotted owls on the Olympic Peninsula Study Area: 1987-2002. We defined fecundity as the number of female young produced per female owl, assuming a 50:50 sex ratio of offspring. .

Year	Number of territories	Number females			Adults		Subadults		Age unknown		Combined	
		Adult	Subadult	Unknown age	f̂	SE	f̂	SE	f̂	SE	f̂	SE
1987	19	18	0	1	0.083	0.061	-	-	0.000	-	0.079	0.058
1988	27	25	0	2	0.240	0.077	-	-	0.250	0.250	0.241	0.072
1989	39	39	0	0	0.539	0.070	-	-	-	-	0.539	0.070
1990	52	46	5	1	0.467	0.065	0.100	0.100	0.000	-	0.423	0.060
1991	53	50	3	0	0.310	0.064	0.167	0.167	-	-	0.302	0.061
1992	63	57	6	0	0.658	0.053	0.500	0.183	-	-	0.643	0.051
1993	54	49	0	5	0.000	-	-	-	0.000	-	0.000	-
1994	56	53	1	2	0.415	0.057	0.000	-	0.000	0.000	0.393	0.055
1995	36	36	0	0	0.000	-	-	-	-	-	0.000	-
1996	50	43	3	4	0.558	0.067	0.333	0.167	0.500	0.289	0.540	0.062
1997	45	43	0	2	0.314	0.067	-	-	0.000	0.000	0.300	0.064
1998	45	39	3	3	0.308	0.065	0.500	0.289	0.167	0.167	0.311	0.060
1999	12	11	0	1	0.000	-	-	-	0.000	-	0	-
2000	30	29	0	1	0.017	0.017	-	-	0.000	-	0.017	0.017
2001	34	33	0	1	0.364	0.076	-	-	0.000	-	0.382	0.076
2002	30	28	0	2	0.446	0.087	-	-	0.500	0.500	0.450	0.084